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IN RE APPLICATION OF: Per-Goran ANDERMO, et al.

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FOR: MOBILE TELECOMMUNICATION SYSTEM

REQUEST FOR PRIORITY UNDER 35 U.S.C. 119 AND THE INTERNATIONAL CONVENTION

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

In the matter of the above-identified application for patent, notice is hereby given that the applicant claims as priority:

COUNTRY	APPLICATION NO.	DAY/MONTH/YEAR
SWEDEN	9802387-2	03 JULY 1998

A certified copy of the corresponding Convention application(s) was submitted to the International Bureau in PCT Application No. **PCT/SE99/01213.**

Respectfully submitted,
OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Marvin J. Spivak
Attorney of Record
Registration No. 24,913
Surinder Sachar
Registration No. 34,423

22850

(703) 413-3000
Fax No. (703) 413-2220
(OSMMN 1/97)

PRV

PATENT- OCH REGISTRERINGSVERKET
Patentavdelningen

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Intyg
Certificate

Härmed intygas att bifogade kopior överensstämmer med de handlingar som ursprungligen ingivits till Patent- och registreringsverket i nedannämnda ansökan.

This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

(71) *Sökande* / *Applicant (s)* — *Radio Design Innovation TJ AB, Kista SE*

(21) *Patentansökningsnummer* / *Patent application number* — *9802387-2*

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SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Stockholm, 1999-07-23

För Patent- och registreringsverket
For the Patent- and Registration Office

Emma Johnsson

Avgift
Fee

PATENT- OCH REGISTRERINGSVERKET
SWEDEN

Postadress/Adress
Box 5055
S-102 42 STOCKHOLM

Telefon/Phone
+46 8 782 25 00
Vx 08-782 25 00

Telex
17978
PATOREG S

Telefax
+46 8 666 02 86
08-666 02 86

MÅ:mam

APPLICANT: RADIO DESIGN INNOVATION TJ AB

TITLE OF THE INVENTION: MOBILE TELECOMMUNICATION SYSTEM

Field of the invention

The present invention relates to a method and an arrangement in a mobile telecommunication system using lobes for establishing and maintaining a radio channel between a mobile station (MS) and a base station (BS).

Background of the invention

In a cellular system with a phased array antenna system narrow lobes are generated by a lobe shaping unit (LSU). These narrow lobes are directed towards mobile stations.

At call set up the direction of a mobile station within a sector is unknown. Narrow lobes cannot be established until the direction is known. The invention gives a solution on how to find both the initial direction of the mobile terminal and to detect the initial signalling. An algorithm is also described how to change from a wide lobe to a narrow lobe during call set up.

A similar problem exists when a handover is carried out between sectors or base sites.

A similar method is used for signal strength measurements.

Summary of the invention

Thus, the object of the invention is to find the initial direction of a mobile terminal, detect the initial signalling, establish and maintain a connection between the base station and the mobile station.

This object is achieved by means of a method and an arrangement according to claims 1 and 9, respectively.

Other characteristics of the invention are set out in the dependent claims.

Brief description of the drawing

A preferred embodiment of the invention will now be given below with reference to the only drawing:

Figure 1 discloses the construction of the lobe shaping system including the

Direction Finding Unit according to the invention.

Detailed description of an embodiment of the invention

In the following description certain abbreviations are used throughout the text. First these abbreviations will be explained, after which the invention will be described with reference to Figure 1.

DFU	Direction Finding Unit
MS	Mobile Station
MTX	Mobile Telephone Exchange
BSC	Base Site Controller for control of LSU and DFU
BS	Base Station
TRX	Transceiver Equipment (Transmitter/Receiver Equipment)
CC	Calling Channel
TCfree	free Traffic Channel
TCho	Traffic Channel receiving handover from another channel
RSS	Radio Signal Strength
RSSI	Radio Signal Strength Indicator
LSU	Lobe Shaping Unit
SSM	Signal Strength Measurement
SR	Signal Strength Receiver or TRX used for signal strength measurements

In addition to conventional equipment as for example transmitter/receiver equipment (TRX), antenna means, control means for establishing channels, means for measuring signal strength connected to supervising means for handover decisions, the base station (BS) of the present invention also includes a Direction Finding Unit (DFU) and lobe shaping units (LSU). The RSSI-records, RSSI and fast scanning switch of figure 1 constitute the DFU. The MTX constitutes the interface to the fixed public or private network, e.g. POTS, ISDN. The MTX is considered to be the most complex part of the mobile communication system, and all final decisions regarding handover, roaming, call set up etc. emanates from the MTX. The TRX is connected to a lobe shaping unit (LSU) which in turn is connected to an antenna array. The lobe shaping unit (LSU) is arranged to form lobes with different widths and gains in arbitrary directions in both uplink and downlink by altering phase- and amplitude coefficients. The lobe shaping unit is described in detail in pending patent applications, assigned to Radio Design Innovation TJ AB, which applications are incorporated herein by reference.

Now, returning to the DFU its responsibility resides in the localisation of a mobile station (MS) as fast as possible in order to avoid that the signalling between the MTX and the MS is lost. This function is particularly required during a call set-up or in handover situations when the position of the MS initially is unknown to the BSC. The above localisation is achieved by allocating narrow antenna lobes (using LSU and antenna array) covering the whole area inside a sector. The DFU simultaneously or preferably sequentially scans all receiving lobes. Upon detection of received signal strength in one or a multitude of the receiving lobes the lobe with highest signal strength is selected and the BSC establishes a configured lobe in the direction of the selected lobe for communication between the MS and a TRX. It should of course be realised that the MS, before sending signals to the BS, must identify the BS. This is achieved by the BS transmitting identification signals in a wide lobe in order to inform MS, covered by said wide lobe, about its existence.

A function procedure scheme for the DFU is described below.

1. Upon receiving a CC, TCfree or TCho activation order (MTX sends order to a TRX-unit), the BSC activates the DFU and the DFU is set to correct channel number and monitors the received signal. A wide lobe in the LSU is connected to the transmitter.

2. The MS activates its transmitter as response to a paging to set up a MS initiated call on a new frequency after a handover order. Power starts to ramp up and before frame data is transmitted, the DFU must have identified the lobe with strongest RF-level. The BSC sets up a path through the equipment with the selected lobe connected to the receiver.

3. During the reception of NMT-frames the DFU measures RSS and keeps a record of each lobe. The BSC reads the RSSI records from the DFU and connects continuously the best lobe to the receiver.

4. At a suitable point in the signalling scheme the BSC reads the RSSI record from the DFU and decides which lobe is best to use for transmitter part and connects the best lobe in that direction to the transmitter, i.e. wide lobe is transformed into a narrow lobe.

5. During the signalling and speech conversion, the DFU measures RSSI and the BSC continuously connects the best lobe to receiver and transmitter.

A similar method as above is used for signal strength measurements. The responsibility for the SSM function is to connect a SR unit (or channel unit) to the

best lobe so that signal strength measurements can be performed by the SR unit, on the best lobe. The RSSI measurements are initiated from the MTX.

The SSM function uses the same hardware configuration as the DFU function.

A function scheme for the SSM function is described below.

1. Upon receiving a measurement activation order (MTX sends order to a TRX or SR unit), the BSC activates the DFU and the DFU is set to correct channel number and monitors the received signal.

2. The DFU identifies the lobe with the strongest RF-level. The BSC sets up a path through the equipment with the selected lobe connected to the SR.

3. SR performs RSSI and Ø-tone measurements. In for example Nordic Mobile Telephone (NMT) quality of a call is controlled by a control signal (Ø-tone) i.e. one of four tones around 4kHz. The base station transmits the Ø-signal to the mobile station which returns the signal to the base station. The quality of the returned Ø-signal is measured in the base station and if the quality is below a predetermined value the base station transmits an alarm to an MTX. Then, the MTX orders the base station and surrounding base stations to measure the strength of the radio signal from the mobile station. The base stations send the measurement results to the MTX, after which the MTX connects the call to the base station with highest received signal strength.

4. The DFU monitors the received signal and the BSC continuously connects the best lobe to the SR. After the RX is ready BSC disconnects SR equipment.

It would be appreciated by those of ordinary skill in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential character thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restrictive. The scope of the inventions indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalence thereof are intended to be embraced therein.

CLAIMS

1. A method in a mobile telecommunication system using lobes for establishing and maintaining a radio channel between a mobile station (MS) and a base station (BS), **characterized** by the steps of:

measuring received signal strength (RSS) or signal quality in each lobe in a sector;

selecting the lobe with highest received signal strength (RSS) or signal quality;

connecting the transceiver equipment of the base station (BS) to the mobile station (MS) using the selected lobe.

2. A method as claimed in claim 1, **characterized** in that the base station (BS) measures the received signal strength (RSS) or signal quality of the lobes in the sector sequentially.

3. A method as claimed in claims 1 or 2, **characterized** in that a DFU in the base station (BS) measures the received signal strength (RSS) or signal quality in each lobe in the sector, and stores the values of the received signal strength or signal quality for each lobe in a memory (RSSI-records).

4. A method as claimed in claim 3, **characterized** in that a base site controller (BSC) reads the values in the memory (RSSI-records) and decides which lobe has the highest received signal strength or signal quality selecting that lobe direction for communication with the mobile station.

5. A method as claimed in claim 4, **characterized** in that the base site controller (BSC) configures a lobe shaping unit (LSU) to establish a preferable lobe, e.g. narrower lobe, in the direction of the selected lobe towards the mobile station for the downlink and/or uplink respectively.

6. A method as claimed in claim 5, **characterized** in that the base site controller (BSC) allocates a traffic channel (TC) between a transmitter/receiver equipment (TRX) in the base station and the lobe shaping unit (LSU), wherein the traffic channel is established between the base station (BS) and the mobile station (MS).

7. A method as claimed in any preceding claims **characterized** in that it is used at call set up and/or at handover between sectors.

8. A method as claimed inclaim7, **characterized** in that a SSM (Signal strength measurement)-equipment in the base station connects a SR (signal strength receiver)-unit to the selected lobe with highest received signal strength (RSS) or signal quality, wherein the SR-unit performs signal strength measurements or Ø-tone measurements in this selected lobe for handover purposes.

9. An arrangement in a mobile telecommunication system using lobes for establishing and maintaining a radio channel between a mobile station (MS) and a base station (BS), **characterized** in that a Direction Finding Unit (DFU) in the

base station (BS) is arranged to measure the received signal strength (RSS) or signal quality in each lobe, select the lobe with highest received signal strength or signal quality, and connect this lobe to an arbitrary TRX-equipment in the base station (BS).

10. An arrangement as claimed in claim 9, **characterized** in that the DFU includes a RSSI-record, RSSI-unit and a fast scanning switch.

11. An arrangement as claimed in claim 10, **characterized** in that the DFU reads RSSI and keeps a RSSI-record for each lobe.

12. An arrangement as claimed in claims 10 or 11, **characterized** in that the BSC reads the RSSI-record of the DFU and connects continuously the best lobe to the receiver (SR).

ABSTRACT

The invention relates to a method and an arrangement in a mobile telecommunication system using lobes for establishing and maintaining a radio channel between a mobile station and a base station. The base station measures received signal strength or signal quality in each lobe in a sector by means of a Direction Finding Unit (DFU). The DFU selects the lobe with the highest received signal strength or signal quality and connects the transceiver equipment of the base station to the mobile station using the selected lobe.

(Figure 1)

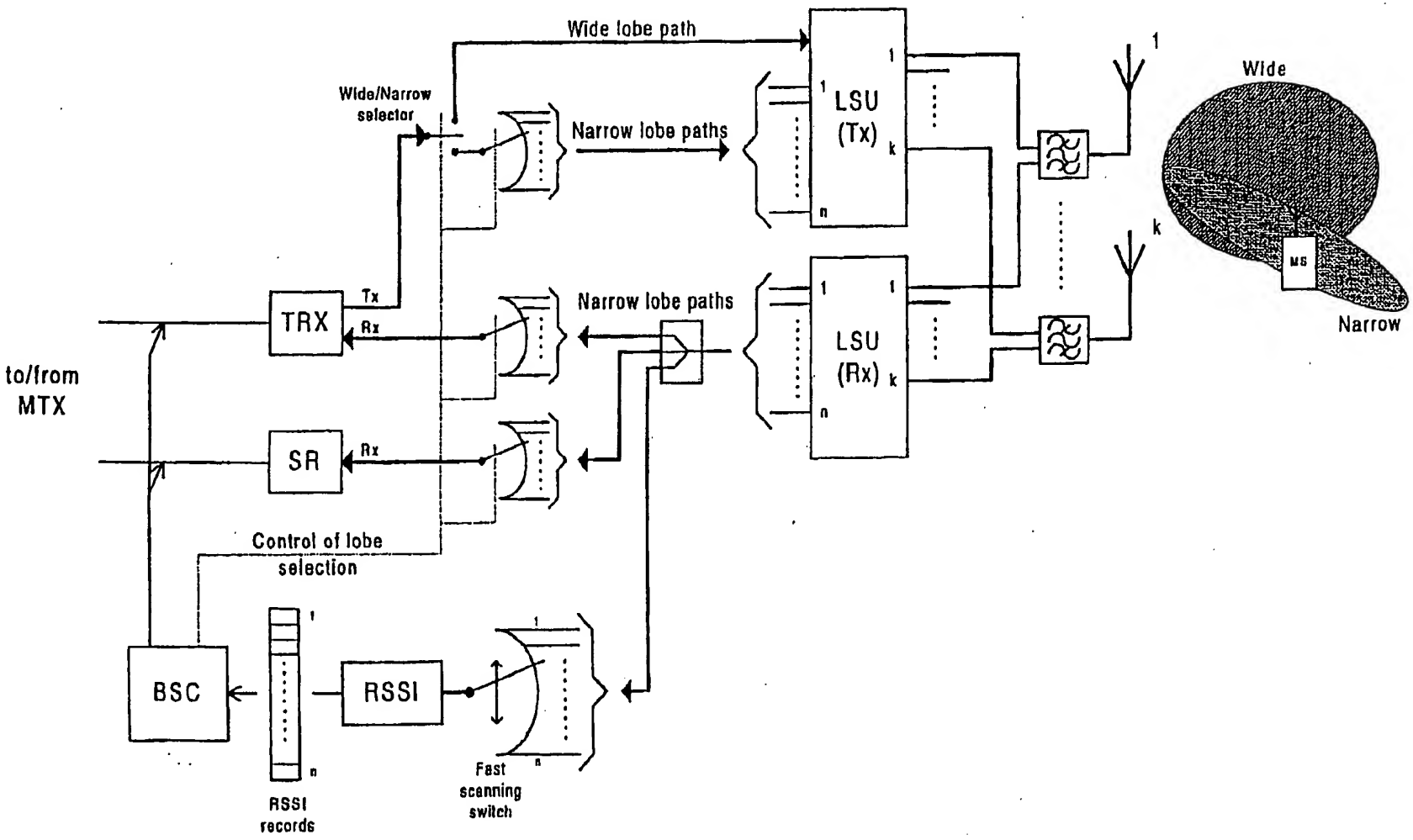
Wide lobe path
Wide/Narrow selector
Narrow lobe paths
LSU (Tx)
LSU (Rx)
Narrow lobe paths
TRX
Tx
Rx
SR
Rx
to/from MTX
Control of lobe selection
BSC
RSSI
RSSI records
Fast scanning switch
Wide
Narrow
MS

Figure 1